Assessment of Direct and Indirect GHG Emissions Associated with Petroleum Fuels

Study Overview
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Study Objectives

- Identify direct and indirect emissions associated with petroleum fuels
- Estimate emissions that are not included in traditional LCAs
- Categorize emissions as direct and indirect
- Provide recommendations for further analysis

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Petroleum Production Impacts

- Facility construction
- Oil exploration
- Oil production
- Oil refining
- Transport
- Vehicle

- Heavy oil
- Forest clearing
- Forest roads
- Residual oil
- Petroleum coke
- Protection of oil supply
- Venting and flaring



Emissions included in LCA studies

- Included in traditional fuel life cycle analysis
- OExcluded from traditional fuel life cycle analysis because relative difference among fuels is small
- Not included in traditional full fuel life cycle analyses
- Include in traditional fuel life cycle analyses and needs much work
- Not applicable

Petroleum Infrastructure

- Oil production and refining
 - Several studies looking at oil sands and conventional oil production and refining
- Land Use Conversion
 - Several studies looking at direct LUC
 - Road indirect LUC? Priced induced LUC?
- Fate of residual oil and petroleum coke
 - Bunker fuel for marine transport price effect
 - Transportation logistics
 - Market substitution in power sector
 - Considered in PwC GtL GHG study
 - Requires economic modeling

Other Petroleum Effects

- Economic impacts
 - Effect of prices
 - GHGs be integrated into global CGE studies
 - Requires more detailed petroleum sectors
- Military activity
 - Hard to agree on approach
 - What is direct
 - Indirect
 - Economic effects are often cited

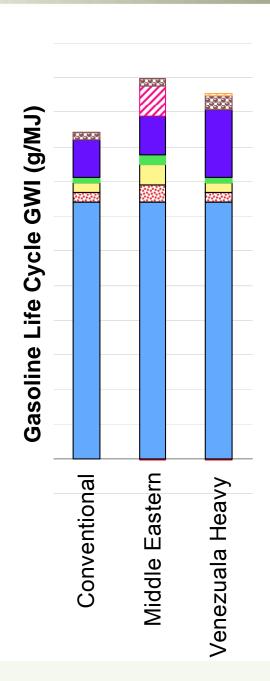
	Direct Effects									Indirect Effects					
Petroleum Supply Option	Oil Exploration	Oil Production	Methane losses, flaring	Oil Refining	Transport	Land Use Conversion	Tailing lakes, CH₄	Vehicle fuel	Exhaust minor species	Material inputs	Refinery Co-products	Macro Economic Effects	Protection of oil supply	Iraq Reconstruction	Indirect land Use
Venezuelan Heavy	•	•	•	•	0	•	_			0	•	•	•	•	•
Canadian Oil Sands	•	0	•	0	0	•	•			•	•	•	-	•	_
Iraqi	•	•	•	0	0		_			0	•	•	•	_	_
Nigerian	•	•	•	0	0	_	_			0	•	•	_	_	_
California TEOR	•	•	•	0	0	•	_			0	•	•	_	•	_
U.S. Off Shore	•	•	•	0	0	_	_			•	•	•	_	_	_
Conventional	•			0	0	•	_			0	•	•	_	_	_

Life Cycle Associates Example Results

Life Cycle
GHG
Emissions
for Gasoline

Direct + Indirect

Vehicle + Fuel Cycle



- Mary Coproducts
- ☑ Protection of Supply
- Refining
- Transport
- □ Venting and Flaring
- Production
- Fuel Combustion
- Rebound